

WHAT IS CLAIMED IS:

5

1. A structural adhesive layer activatable upon exposure to actinic radiation, said structural adhesive layer comprising:

(a) a layer of adhesive material, wherein the adhesive material is a mixture of:

10

(i) about 20 to about 80 weight percent of one or more epoxy resins;

(ii) about 20 to about 50 weight percent of one or more resins selected from polyester resins, ethyl vinyl acetate resins, and acrylate resins;

15

(iii) up to about 30 weight percent of one or more hydroxy-containing compounds;

(iv) up to about 5 weight percent of one or more photoinitiators; and

20

(v) up to about 50 weight percent of one or more additives; wherein all weight percentages are based on a total weight of the mixture; and

25

(b) at least one web of fibers at least partially embedded within the layer of adhesive material, wherein the at least one web of fibers has a basis weight of less than about 30 grams per squaremeter, an air permeability value of more than about 600 cfm/ft<sup>2</sup> (3.04 m<sup>3</sup>/m<sup>2</sup>/sec) as measured by ASTM D737-75 or ASTM D737-80, a light permeability value of more than about 10% as measured by Light Permeability Test LPT, and comprises fibers having an average fiber diameter of less than about 20 microns.

30

2. The structural adhesive layer of Claim 1, wherein the layer of adhesive material comprises a mixture of:

(i) about 30 to about 60 weight percent of one or more epoxy resins;

35

(ii) about 30 to about 40 weight percent of one or more resins selected from polyester resins, ethyl vinyl acetate resins, and (meth)acrylate resins;

(iii) about 9 to about 20 weight percent of one or more hydroxy-containing compounds;

(iv) up to about 2 weight percent of one or more photoinitiators; and

(v) up to about 10 weight percent of one or more additives; wherein all weight percentages are based on the total weight of the mixture.

3. The structural adhesive layer of Claim 2, wherein the layer of adhesive material comprises a mixture of:

(i) about 30 to about 60 weight percent of one or more epoxy resins;

(ii) about 30 to about 40 weight percent of polyester resin;

(iii) about 9 to about 20 weight percent of one or more hydroxy-containing compounds; and

(iv) up to about 1 weight percent of one or more photoinitiators; wherein all weight percentages are based on the total weight of the mixture.

4. The structural adhesive of Claim 3, wherein the layer of adhesive material comprises a mixture of:

(i) about 27 weight percent of a first epoxy resin having an epoxy equivalent weight of about 185 to about 192, and about 22 weight percent of a second epoxy resin having an epoxy equivalent weight of about 525 to about 550;

(ii) about 30 weight percent of a polyester resin, wherein the polyester resin is an amorphous branched copolyester having a glass transition temperature of less than about -5°C;

(iii) about 10 weight percent of a first hydroxy-containing compound comprising a micronized phenoxy resin having a number average molecular weight of from about 10,000 to about 16,000 and a hydroxy equivalent weight of about 284, and about 10 weight percent of a second hydroxy-containing compound comprising a polyol adduct of glycol and propylene oxide having a number average molecular weight of about 700 and a hydroxy equivalent weight of about 38; and

(iv) about 1 weight percent of one or more photoinitiators; wherein all weight percentages are based on the total weight of the mixture.

5           5.    The structural adhesive layer of Claim 4, wherein the at least one web of fibers has a basis weight of less than about 25 grams per square meter, an air permeability value of more than about 800 cfm/ft<sup>2</sup> (4.06 m<sup>3</sup>/m<sup>2</sup>/sec) as measured by ASTM D737-75 or ASTM D737-80, a light permeability value of more than about 75% as  
10           measured by Light Permeability Test LPT, and comprises polyester fibers having an average fiber diameter of less than about 7 microns.

          6.    The structural adhesive layer of Claim 1, wherein the layer of adhesive material comprises a mixture of:

15                   (i) about 30 to about 60 weight percent of one or more epoxy resins;

                  (ii) about 30 to about 40 weight percent of one or more ethyl vinyl acetate resins;

20                   (iii) about 9 to about 20 weight percent of one or more hydroxy-containing compounds;

                  (iv) up to about 2 weight percent of one or more photoinitiators; and

                  (v) up to about 10 weight percent of one or more additives; wherein all weight percentages are based on the total weight  
25           of the mixture.

          7.    The structural adhesive layer of Claim 6, wherein the layer of adhesive material comprises a mixture of:

30                   (i) about 27 weight percent of a first epoxy resin having an epoxy equivalent weight of about 185 to about 192, and about 22 weight percent of a second epoxy resin having an epoxy equivalent weight of about 525 to about 550;

                  (ii) about 30 weight percent of an ethyl vinyl acetate resin, wherein the ethyl vinyl acetate resin comprises about 70 weight  
35           percent vinyl acetate;

                  (iii) about 10 weight percent of a first hydroxy-containing compound comprising a micronized phenoxy resin having a

number average molecular weight of from about 10,000 to about 16,000 and a hydroxy equivalent weight of about 284, and about 10 weight percent of a second hydroxy-containing compound comprising a polyol adduct of glycol and propylene oxide having a number average molecular weight of about 700 and a hydroxy equivalent weight of about 38; and

(v) about 1 weight percent of one or more photoinitiators; wherein all weight percentages are based on the total weight of the mixture.

8. The structural adhesive layer Claim 7, wherein the at least one web of fibers has a basis weight of less than about 10 grams per square meter, an air permeability value of more than about 1200 cfm/ft<sup>2</sup> (6.09 m<sup>3</sup>/m<sup>2</sup>/sec) as measured by ASTM D737-75 or ASTM D737-80, a light permeability value of more than about 90% as measured by Light Permeability Test LPT, and comprises nylon fibers having a trilobal cross-sectional shape and an average fiber diameter of less than about 20 microns.

9. The structural adhesive layer of Claim 1, wherein the layer of adhesive material comprises a mixture of:

(i) about 20 to about 80 weight percent of one or more epoxy resins;

(ii) about 30 to about 40 weight percent of one or more acrylate resins;

(iii) about 9 to about 20 weight percent of one or more hydroxy-containing compounds;

(iv) up to about 3 weight percent of one or more photoinitiators; and

(v) up to about 10 weight percent of one or more additives; wherein all weight percentages are based on the total weight of the mixture.

10. The structural adhesive layer of Claim 9, wherein the layer of adhesive material comprises a mixture of:

(i) about 53.9 weight percent of a first epoxy resin having an epoxy equivalent weight of about 185 to about 192, and

about 9.8 weight percent of a second epoxy resin having an epoxy equivalent weight of about 525 to about 550;

(ii) about 30 weight percent of a (meth)acrylate resin, wherein the (meth)acrylate resin comprises a poly(meth)acrylate elastomer having an ethylene, propylene or butylene repeating unit, wherein the ethylene, propylene or butylene repeating unit molar ratio to (meth)acrylate repeating units is less than about 2;

(iii) about 4.3 weight percent of a hydroxy-containing compound comprising a polyol adduct of glycol and propylene oxide having a number average molecular weight of about 700 and a hydroxy equivalent weight of about 38; and

(iv) about 2 weight percent of one or more photoinitiators; wherein all weight percentages are based on the total weight of the mixture.

11. The structural adhesive layer of Claim 10, wherein the at least one web of fibers has a basis weight of less than about 25 grams per square meter, an air permeability value of more than about 1300 cfm/ft<sup>2</sup> (6.59 m<sup>3</sup>/m<sup>2</sup>/sec) as measured by ASTM D737-75 or ASTM D737-80, a light permeability value of more than about 75% as measured by Light Permeability Test LPT, and comprises polyester fibers having a round cross-sectional shape and an average fiber diameter of less than about 20 microns.

12. A structural bonding tape comprising the structural adhesive layer of Claim 1.

13. The structural bonding tape of Claim 12, wherein the tape further comprises at least one additional layer.

14. The structural bonding tape of Claim 13, wherein the at least one additional layer comprises a release liner, a non-structural adhesive layer, a non-adhesive film, a foil, a paper, a foam, a woven fabric, a nonwoven fabric, a knitted fabric, or a combination thereof.

15. A roll of tape comprising the structural bonding tape of Claim 12.

16. A cured sheet of adhesive comprising the structural adhesive layer of Claim 1.

5 17. A method of making a structural adhesive layer which is activatable upon exposure to actinic radiation, said method comprising: forming a mixture comprising:

(i) about 20 to about 80 weight percent of one or more epoxy resins;

10 (ii) about 20 to about 50 weight percent of one or more resins selected from polyester resins, ethyl vinyl acetate resins, and (meth)acrylate resins;

(iii) up to about 30 weight percent of one or more hydroxy-containing compounds;

15 (iv) up to about 5 weight percent of one or more photoinitiators; and

(v) up to about 50 weight percent of one or more additives; wherein all weight percentages are based on a total weight of the mixture;

20 applying a sheet of the mixture to a substrate;

contacting the sheet with at least one web of fibers so that the at least one web of fibers is at least partially embedded in the sheet, wherein the at least one web of fibers has a basis weight of less than about 30 grams per square meter, an air permeability value of more than about 600 cfm/ft<sup>2</sup> (3.04 m<sup>3</sup>/m<sup>2</sup>/sec) as measured by ASTM D737-75 or ASTM D737-80, a light permeability value of more than about 10% as measured by Light Permeability Test LPT, and comprises fibers having an average fiber diameter of less than about 20 microns.

30 18. The method of Claim 17, wherein the method further comprises:

positioning at least one additional layer on an exposed surface of the structural adhesive layer, wherein the at least one additional layer comprises a release liner, a non-structural adhesive layer, a non-adhesive film, a foil, a paper, a foam, a woven fabric, a nonwoven fabric, a knitted fabric, or a combination thereof.

19. A bonded article comprising:

a first substrate;

a second substrate; and

a structural adhesive layer positioned between the first substrate and the second substrate, wherein the structural adhesive layer comprises:

(a) a layer of adhesive material, wherein the adhesive material is a mixture of:

(i) about 20 to about 80 weight percent of one or more epoxy resins;

(ii) about 20 to about 50 weight percent of one or more resins selected from polyester resins, ethyl vinyl acetate resins, and (meth)acrylate resins;

(iii) up to about 30 weight percent of one or more hydroxy-containing compounds;

(iv) up to about 5 weight percent of one or more photoinitiators; and

(v) up to about 50 weight percent of one or more additives; wherein all weight percentages are based on a total weight of the mixture; and

(b) at least one web of fibers at least partially embedded within the layer of adhesive material, wherein the at least one web of fibers has a basis weight of less than about 30 grams per square meter, an air permeability value of more than about 600 cfm/ft<sup>2</sup> (3.04 m<sup>3</sup>/m<sup>2</sup>/sec) as measured by ASTM D737-75 or ASTM D737-80, a light permeability value of more than about 10% as measured by Light Permeability Test LPT, and comprises fibers having an average fiber diameter of less than about 20 microns;

wherein the structural adhesive layer is activatable upon exposure to actinic radiation and fully curable without heat.

20. The bonded article of Claim 19, wherein the layer of adhesive material comprises a mixture of:

(i) about 27 weight percent of a first epoxy resin having an epoxy equivalent weight of about 185 to about 192, and about 22 weight percent of a second epoxy resin having an epoxy equivalent weight of about 525 to about 550;

(ii) about 30 weight percent of a polyester resin, wherein the polyester resin is an amorphous branched copolyester having a glass transition temperature of less than about -5°C;

5 (iii) about 10 weight percent of a first hydroxy-containing compound comprising a micronized phenoxy resin having a number average molecular weight of from about 10,000 to about 16,000 and a hydroxy equivalent weight of about 284, and about 10 weight percent of a second hydroxy-containing compound comprising  
10 a polyol adduct of glycol and propylene oxide having a number average molecular weight of about 700 and a hydroxy equivalent weight of about 38; wherein all weight percentages are based on the total weight of the mixture; and

(iv) about 1 weight percent of one or more photoinitiators; wherein all weight percentages are based on the total  
15 weight of the mixture; and

wherein the at least one web of fibers has a basis weight of less than about 25 grams per square meter, an air permeability value of more than about 800 cfm/ft<sup>2</sup> (4.06 m<sup>3</sup>/m<sup>2</sup>/sec) as measured by ASTM D737-75 or ASTM D737-80, a light permeability value of more than  
20 about 75% as measured by Light Permeability Test LPT, and comprises polyester fibers having an average fiber diameter of less than about 7 microns.

21. The bonded article of Claim 19, wherein the layer of  
25 adhesive material comprises a mixture of:

(i) about 27 weight percent of a first epoxy resin having an epoxy equivalent weight of about 185 to about 192, and about 22 weight percent of a second epoxy resin having an epoxy  
30 equivalent weight of about 525 to about 550;

(ii) about 30 weight percent of an ethyl vinyl acetate resin, wherein the ethyl vinyl acetate resin comprises about 70 weight percent vinyl acetate;

(iii) about 10 weight percent of a first hydroxy-containing compound comprising a micronized phenoxy resin having a  
35 number average molecular weight of from about 10,000 to about 16,000 and a hydroxy equivalent weight of about 284, and about 10 weight percent of a second hydroxy-containing compound comprising



a polyol adduct of glycol and propylene oxide having a number average molecular weight of about 700 and a hydroxy equivalent weight of about 38; and

(iv) about 1 weight percent of one or more photoinitiators; wherein all weight percentages are based on the total weight of the mixture; and

wherein the at least one web of fibers has a basis weight of less than about 10 grams per square meter, an air permeability value of more than about 1200 cfm/ft<sup>2</sup> (6.09 m<sup>3</sup>/m<sup>2</sup>/sec) as measured by ASTM D737-75 or ASTM D737-80, a light permeability value of more than about 90% as measured by Light Permeability Test LPT, and comprises nylon fibers having a trilobal cross-sectional shape and an average fiber diameter of less than about 20 microns.

22. The bonded article of Claim 19, wherein the layer of adhesive material comprises a mixture of:

(i) about 53.9 weight percent of a first epoxy resin having an epoxy equivalent weight of about 185 to about 192, and about 9.8 weight percent of a second epoxy resin having an epoxy equivalent weight of about 525 to about 550;

(ii) about 30 weight percent of a (meth)acrylate resin, wherein the (meth)acrylate resin comprises a poly(meth)acrylate elastomer having an ethylene, propylene or butylene repeating unit, wherein the ethylene, propylene or butylene repeating unit molar ratio to (meth)acrylate repeating units is less than about 2;

(iii) about 4.3 weight percent of a hydroxy-containing compound comprising a polyol adduct of glycol and propylene oxide having a number average molecular weight of about 700 and a hydroxy equivalent weight of about 38; and

(iv) about 2 weight percent of one or more photoinitiators; wherein all weight percentages are based on the total weight of the mixture; and

wherein the at least one web of fibers has a basis weight of less than about 25 grams per square meter, an air permeability value of more than about 1300 cfm/ft<sup>2</sup> (6.59 m<sup>3</sup>/m<sup>2</sup>/sec) as measured by ASTM D737-75 or ASTM D737-80, a light permeability value of more than about 75% as measured by Light Permeability Test LPT, and

comprises polyester fibers having a round cross-sectional shape and an average fiber diameter of less than about 20 microns.

5           23.   The bonded article of Claim 19, wherein the first substrate comprises plastic, metal, ceramic, glass, cellulosic, elastomeric, rubber, wood materials, or a combination thereof; the second substrate comprises plastic, metal, ceramic, glass, cellulosic, elastomeric, rubber, wood materials, or a combination thereof; and the first substrate is similar or different from the second substrate.

10           24.   The bonded article of Claim 23, wherein the first substrate is different from the second substrate.

15